

Hypoxia Forecasts as a tool for Chesapeake Bay Fisheries

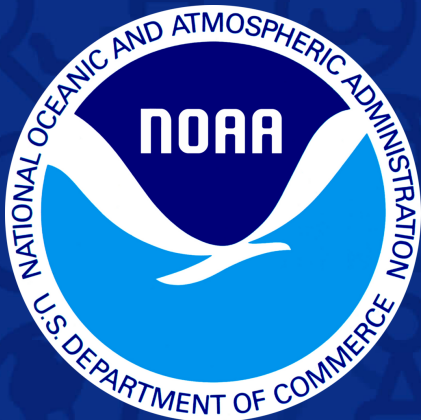
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Overall **COMT** Mission:

- To accelerate transition of coastal ocean modeling research advances to improved operational ocean products and services, meeting the needs of a diverse user community

COMT **Estuarine Hypoxia** Objective:

- To assess the readiness of existing estuarine models for forecasting hypoxia events within the **Chesapeake Bay**

Motivation – Why Chesapeake Bay?

The Chesapeake Bay:

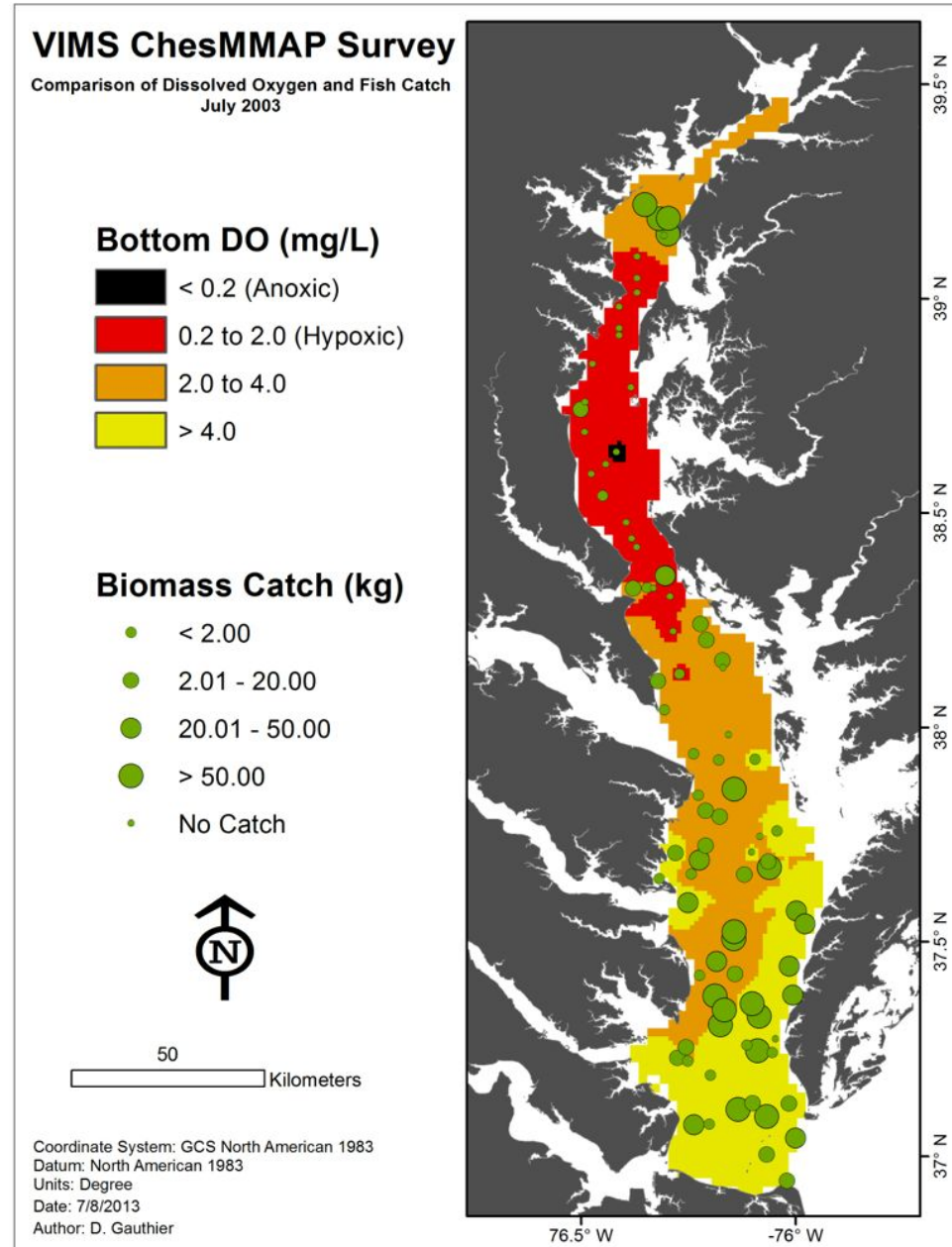
- Largest estuary in U.S.
- Benefits derived from Bay > \$100 Billion annually
- Major anthropogenic impacts threatens Chesapeake's economic/social services
- Additional impacts of climate change are not yet known
- One of longest & most comprehensive data sets (1985-present)



Motivation – Why focus on hypoxia?

Hypoxic (low oxygen) dead zones:

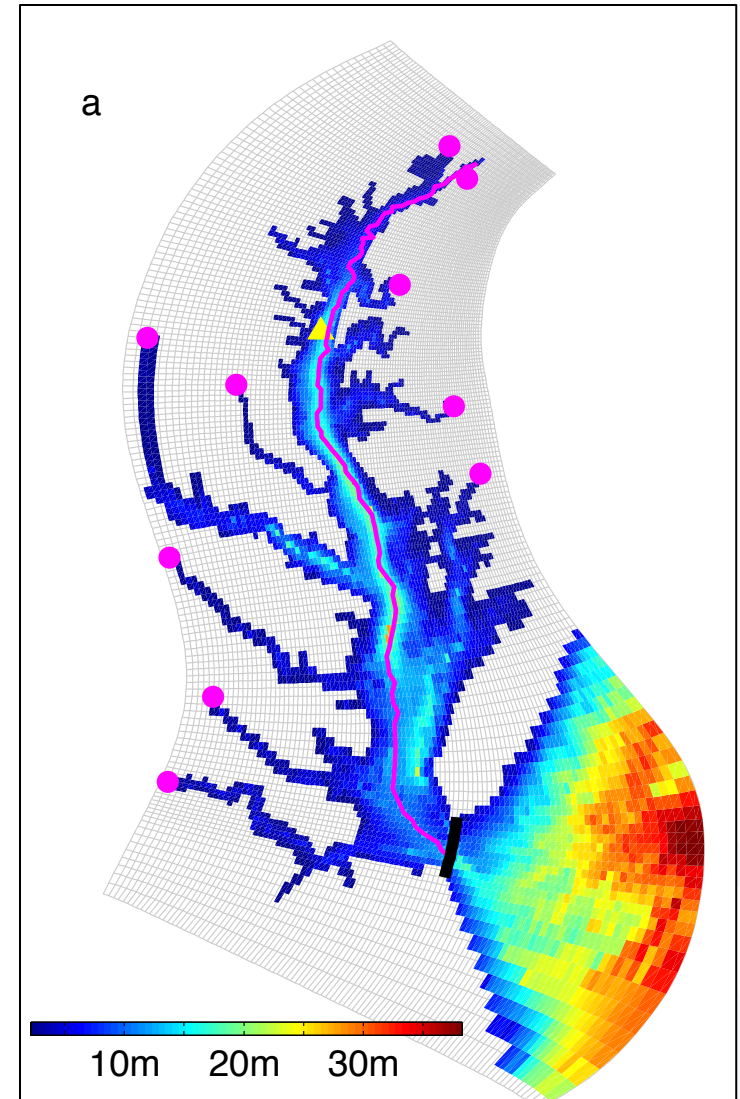
- Excessive nutrient run-off
→ algal blooms → algal decay → dead zones at bottom of the Bay
- Occur in summer:
Warmer temperatures and less mixing
- Impact ecological resources in Bay, particularly demersal fish (low catches where DO < 3 mg/L)



Methods – Hypoxia forecast model

Chesapeake hypoxia models:

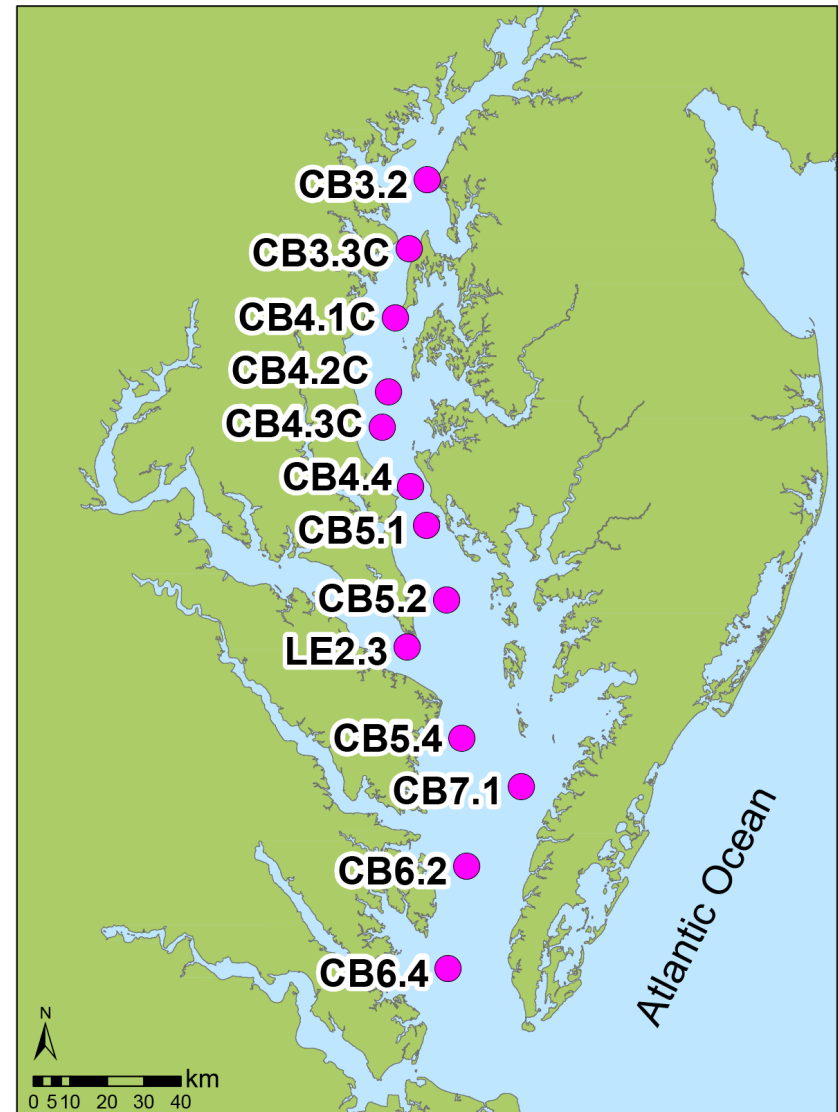
- Multiple model comparison indicated Simple Respiration Model performed as well as more complex models (Irby et al. 2016)
- Apply this to Chesapeake (ChesROMS) grid
- Use same forcing as is used by NOAA's Chesapeake Bay Operational Forecast (CBOFS) forecasts for physical variables (water level, salinity, temperature)



Methods – Evaluate with long term cruise data

Available data:

- Models were assessed by monthly data (semi-monthly in summer) at multiple locations throughout Bay from 1985-present.
- Data includes S, T, DO and multiple other ecological parameters.

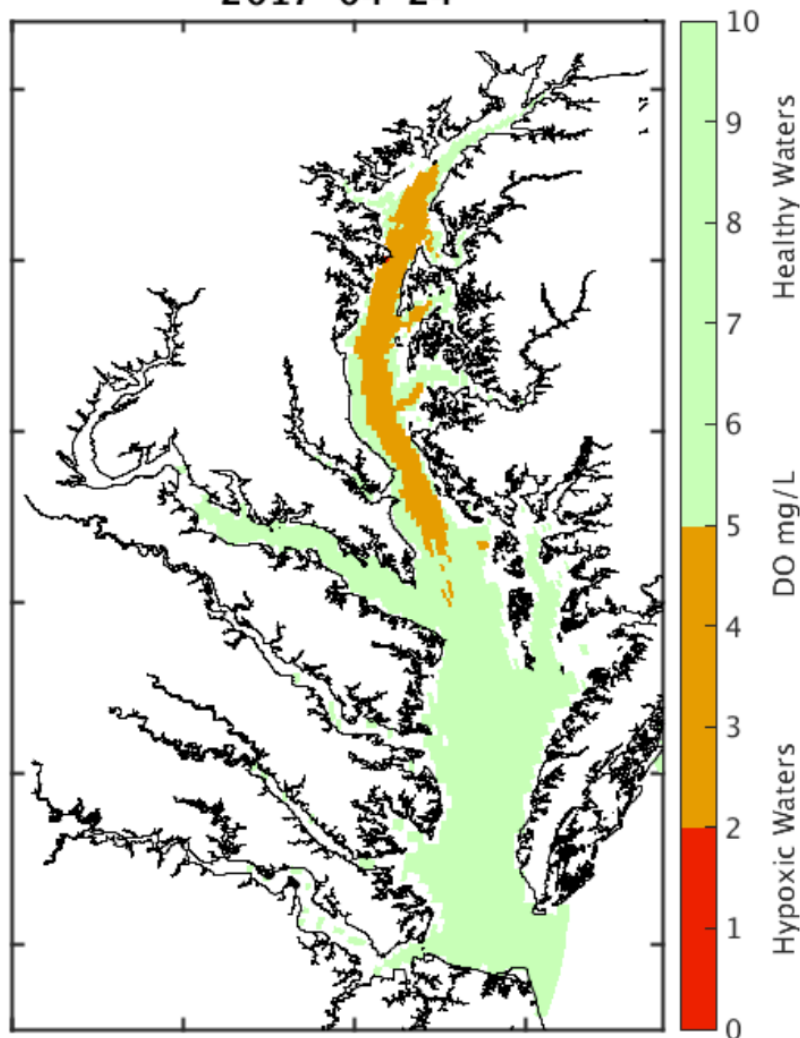


Chesapeake Hypoxia Forecast Tool

http://www.vims.edu/research/topics/dead_zones/forecasts/cbay/index.php

Yesterday's Oxygen Nowcast

2017-04-24



Green → High bottom oxygen

= Good bottom water

= Bottom fish and crabs

Orange → Moderate/low bottom oxygen

= Poor bottom water

= Fewer bottom fish and crabs

Red → Very low bottom oxygen

= Bad bottom water

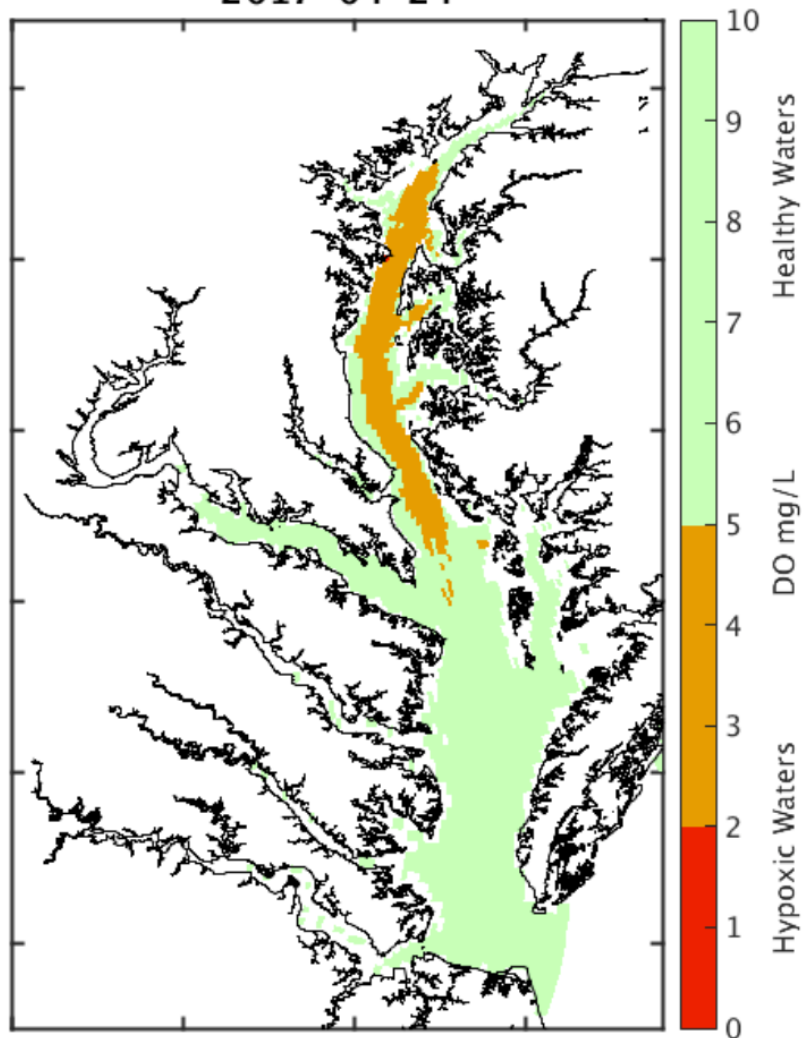
= No bottom fish or crabs

Chesapeake Hypoxia Forecast Tool

http://www.vims.edu/research/topics/dead_zones/forecasts/cbay/index.php

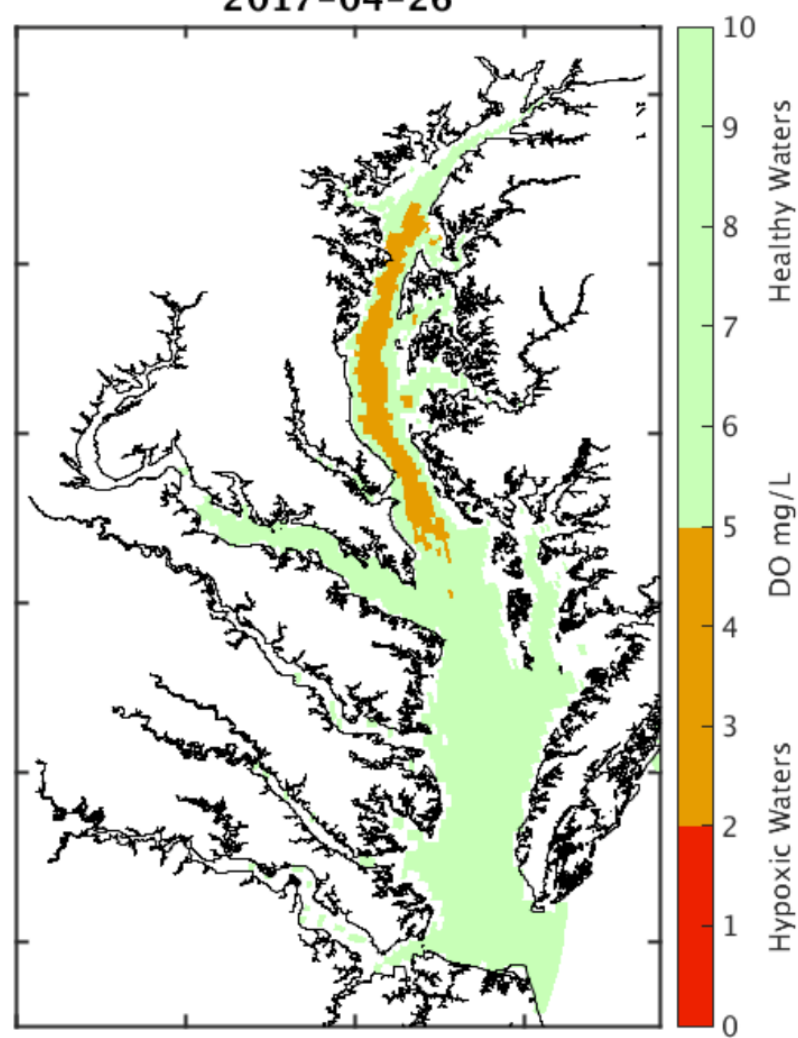
Yesterday's Oxygen Nowcast

2017-04-24



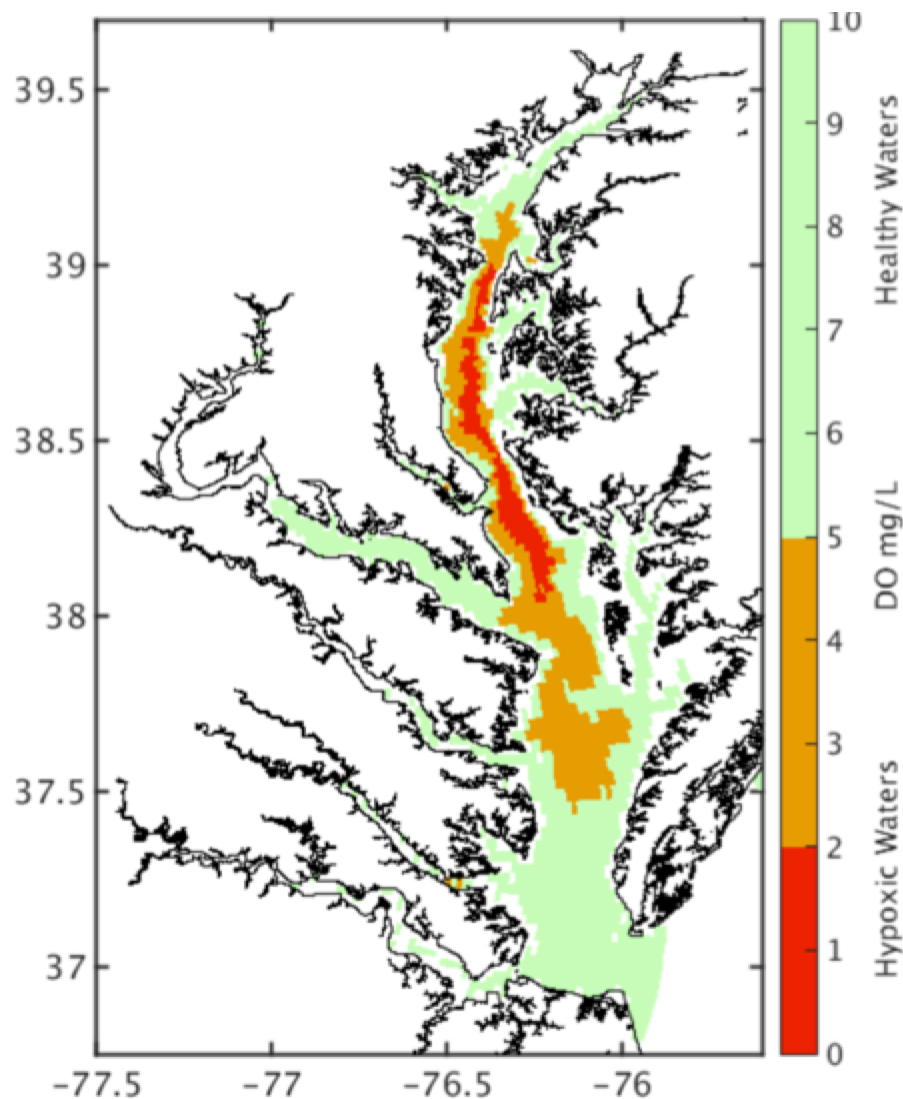
Yesterday's Oxygen Forecast

2017-04-26

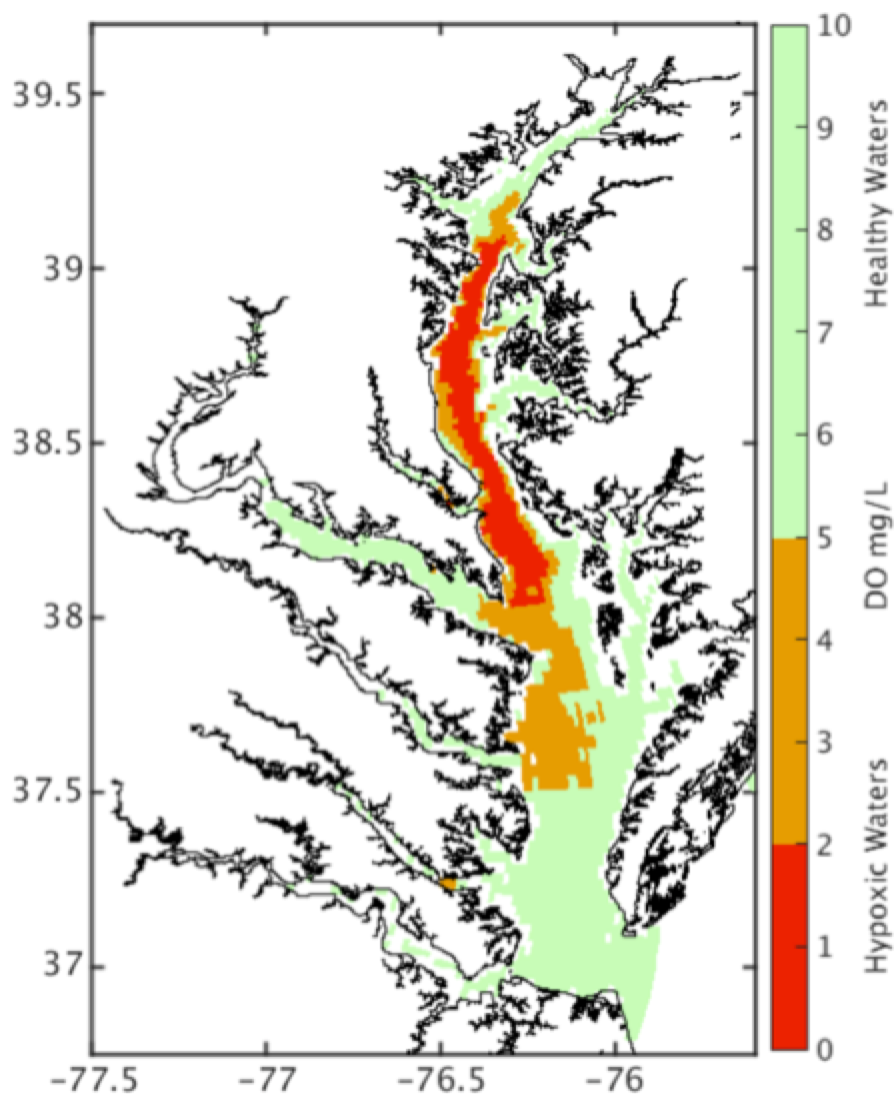


Chesapeake Hypoxia Forecast Tool

1 June 2016 Oxygen Nowcast



3 June 2016 Oxygen Forecast

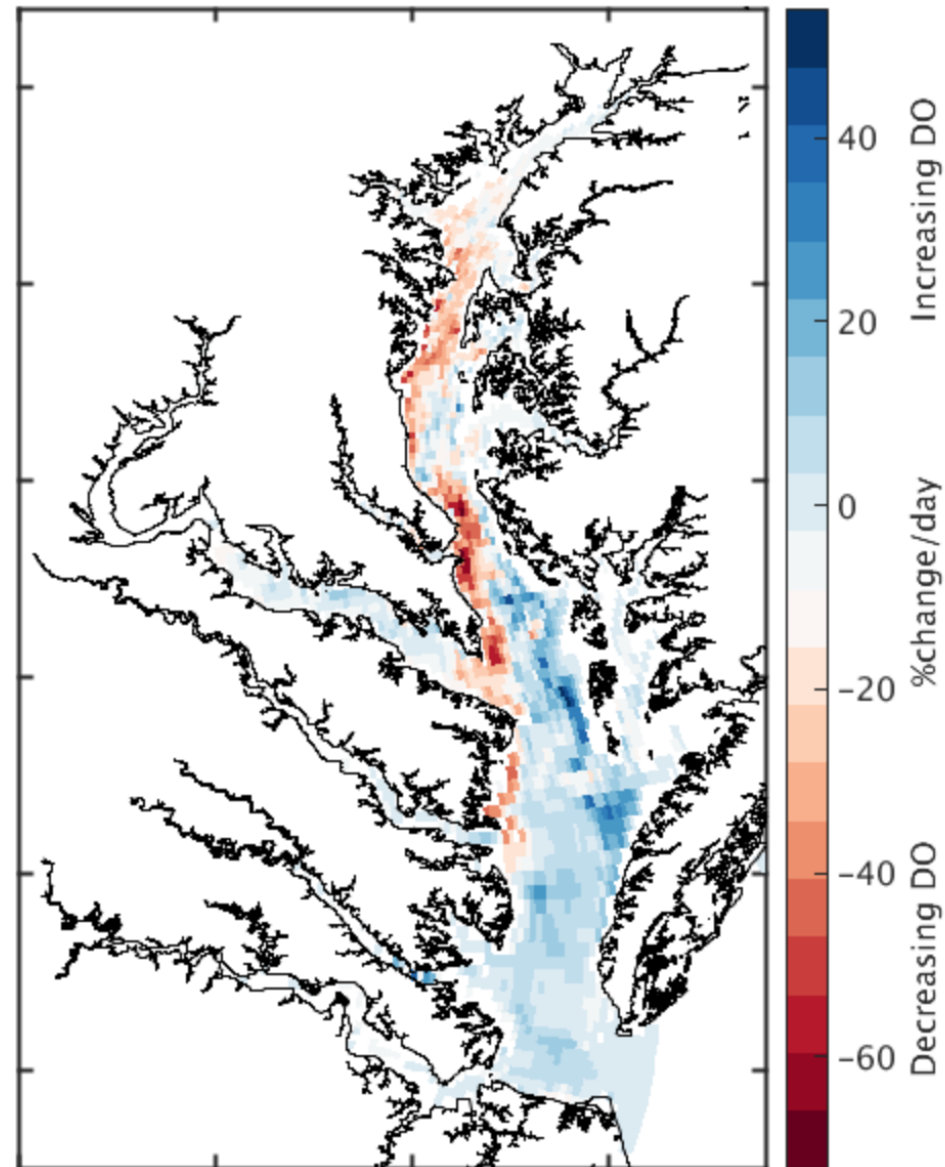


Chesapeake Hypoxia Forecast Tool

Blue → Increasing oxygen
(Improving bottom water in eastern Bay)

Red → Decreasing oxygen
(Degrading bottom water in western Bay)

Forecast Trend
2016-06-01

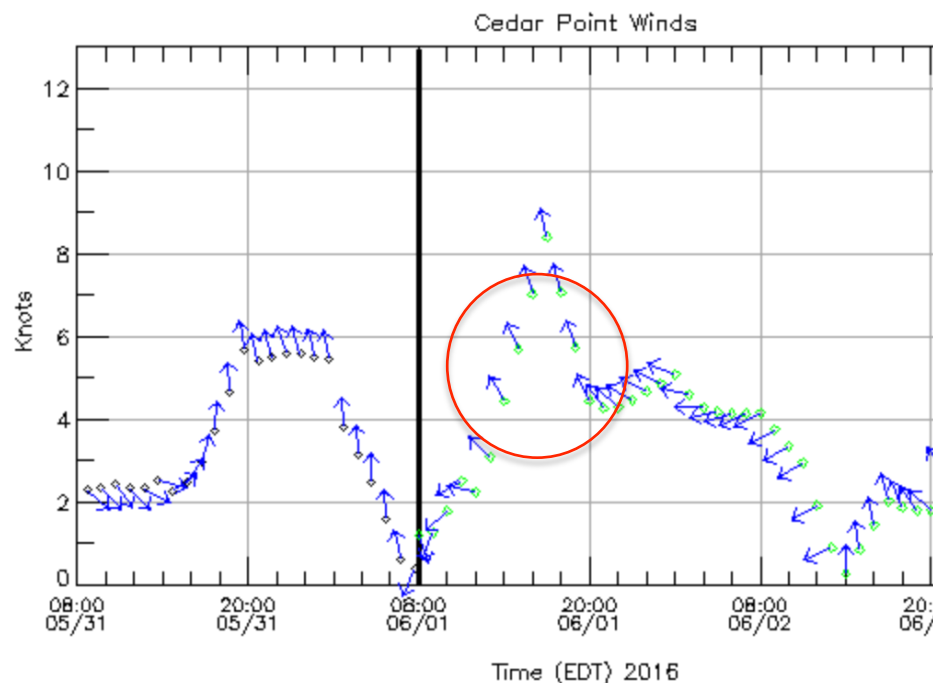


Chesapeake Hypoxia Forecast Tool

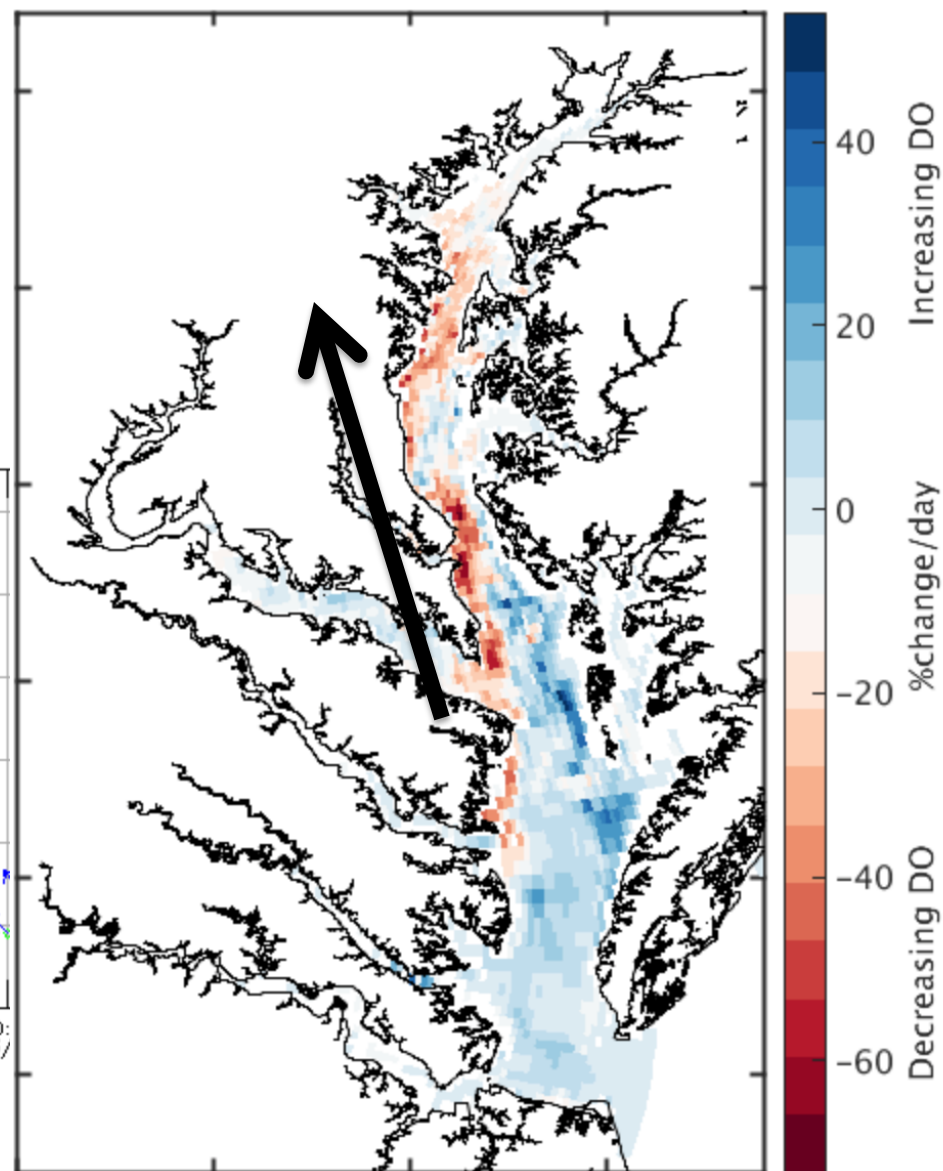
SSE wind transports high oxygen surface water to the east, upwells low oxygen water in west

NOAA/National Ocean Service
Chesapeake Bay Operational
Forecast System (CBQFS2)

Observation:
Nowcast:
Forecast Guidance:



Forecast Trend
2016-06-01



“Quasi-operational” forecasts

on VIMS website:

http://www.vims.edu/research/topics/dead_zones/forecasts/cbay/index.php



transition



Truly operational forecasts

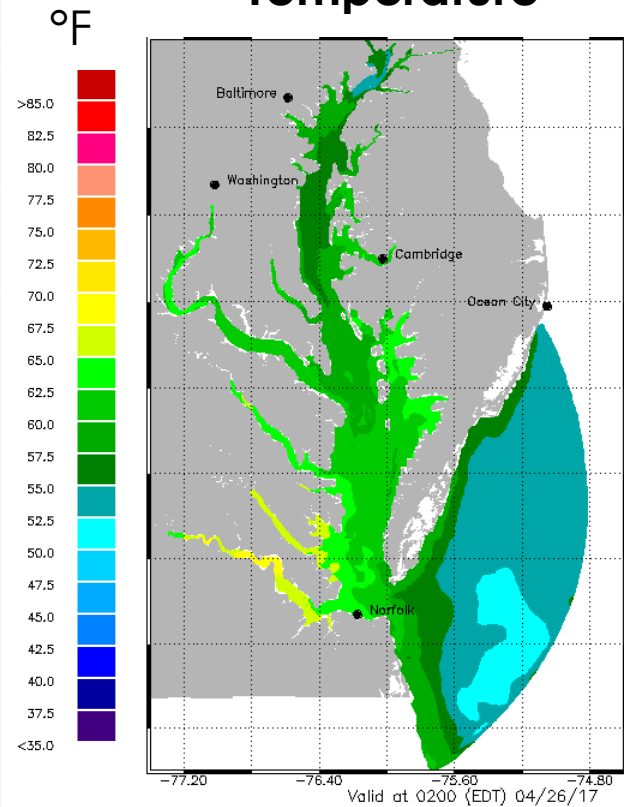
on NOAA on CBOFS site:

<https://tidesandcurrents.noaa.gov/ofs/cbofs/cbofs.html>

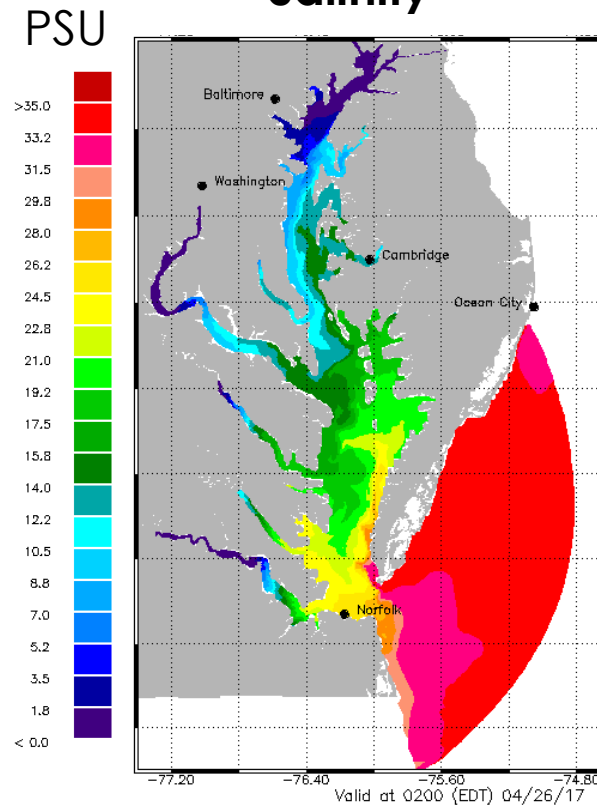
NOAA CBOFS Forecasts

Operational Forecast Site

Surface Temperature



Surface Salinity



**Ecological
Forecasting:**
oxygen/hypoxia?

Time/Date: 0200 (EDT) 04/26/17



Prev

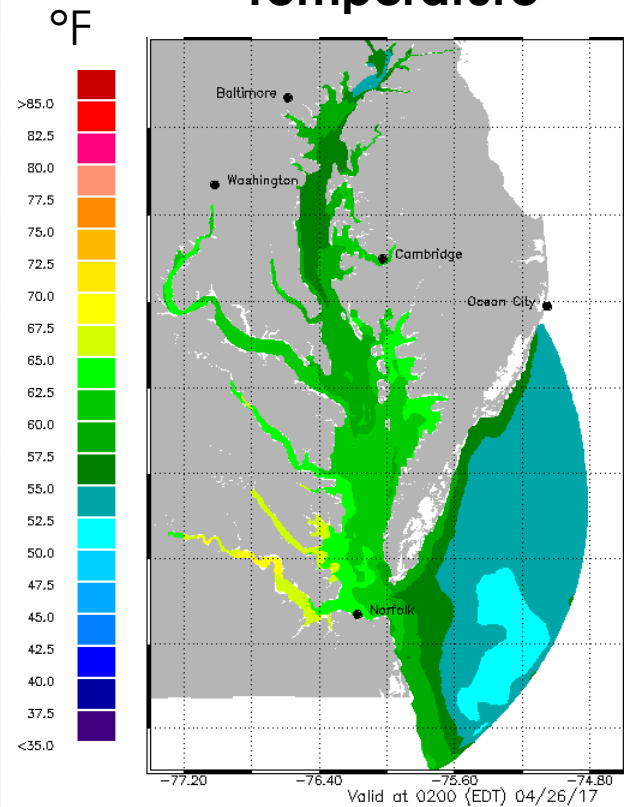
Start Animation

Next

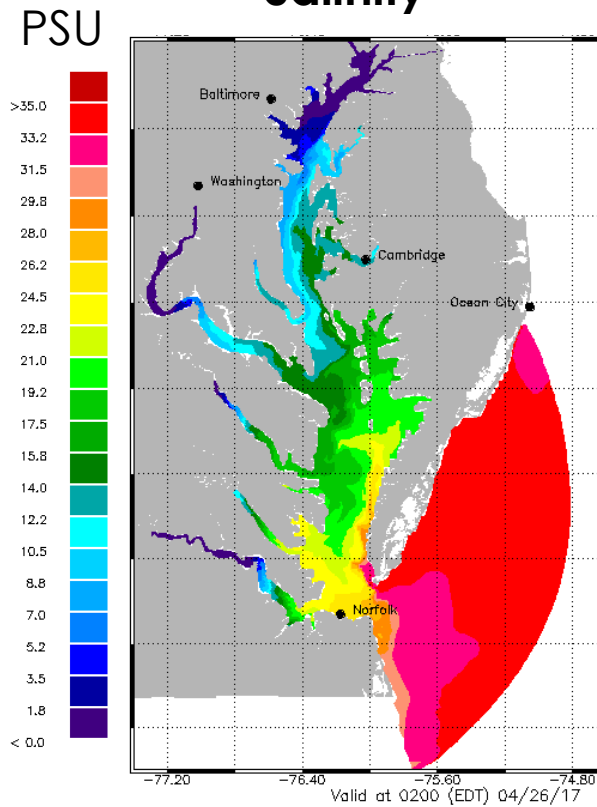
NOAA CBOFS Forecasts

Operational Forecast Site

Surface Temperature

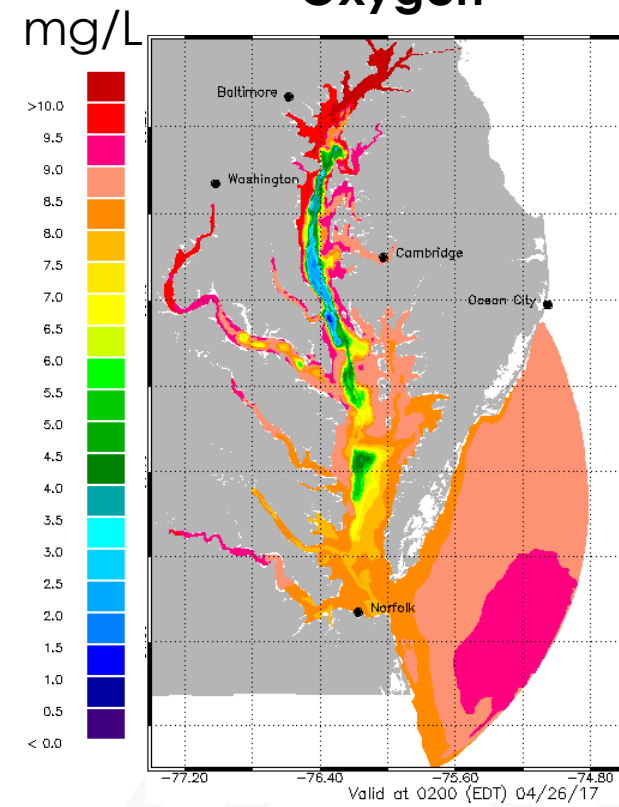


Surface Salinity



Developmental Site

Bottom Oxygen



Time/Date: 0200 (EDT) 04/26/17



Prev

Start Animation

Next

Workshop summary:

- Attendees included fishermen as well as scientists/educators
- Strong enthusiasm for hypoxia forecasts as complementary tool with other information sources
- Several captains already use real-time observations for planning (e.g., water clarity, temperature, wave heights) and/or short-term model forecasts (e.g., currents from CBOFS)
- Little interest in hypoxia forecasts beyond 2-3 days because of limited trust in detailed weather/wind forecasts beyond 2-3 days

Suggestions for Hypoxia Forecast Tool:

- Oxygen at other depths
- Other variables (winds, salinity, temperature, water clarity, algal blooms)
- Model-data time series at observation station locations
- Historical averages as well as current conditions

COMT Estuarine Hypoxia Testbed

- Identified a simple oxygen model that can be easily used to produce hypoxia forecasts in the Chesapeake Bay
- Developed a “quasi-operational” Hypoxia Forecast Tool that has provided forecasts on VIMS website since Jan. 2016
- We have worked with NOAA NOS to get the oxygen formulation in the operational model and results posted to NOAA’s developmental website for the Chesapeake
- Met with Chesapeake Bay Stakeholders to better understand what they are looking for in these forecasts, and the improvements they would like to see in the future

Future work:

Investigating methods for nudging modeled fields to observed high frequency fields (T, S, DO) at 10 locations



Questions?

